

(1) Sodamide is not similar to metallic sodium dissolved in liquid ammonia

Baird teaches desulfurization of organosulfur species using soda amide (NaNH_2). Baird does not teach desulfurization using metallic sodium dissolved in liquid ammonia. Applicant's invention does not use sodamide, but metallic sodium dissolved in liquid ammonia. The examiner has indicated that sodamide is "similar" to a solution of sodium and ammonia. This is simply incorrect. Indeed, such a statement is equivalent to the statement that solution of the elemental components of a molecule are similar to those of the molecule itself, and as is well known, molecular properties are substantially different, sometimes startlingly so, from those of the molecular components: for instance a molecule water is very different from a solution of hydrogen and oxygen gas, a solution of hydrogen chloride is very different from a solution of hydrogen gas and chlorine, and similarly, a solution of sodium and ammonia is substantially different from sodamide.

Sodium in solution with ammonia is chemically, physically and structurally different from sodamide. See Declaration of Dr. Schucker. Sodamide melts at 210°C and boils at 400°C . Sodamide is a molecule, and it is ionic when dissolved in a liquid ammonia with a valence of +1. Conversely, the metallic sodium and ammoniac solution is a solution or suspension of one material in another. The sodium metal melts at about 98°C , while ammonia melts at -78°C and boils at -33°C , well below the melting point of sodamide. (the pressures used in applicant's process enable the use of liquid ammonia). Metallic sodium has a valence of 0 in liquid ammonia. Reactions of metallic sodium (valence 0) in liquid ammonia take place by electron transfer, while reactions of sodium (valence +1) as a salt in sodamide operate through acid/base

mechanisms. Declaration of Dr. Schucker. Sodamide is a molecule, while metallic sodium is a composition of metallic sodium suspended in liquid ammonia. Sodium in liquid ammonia is different chemically, physically and structurally from sodamide, and hence, there is simply no motivation to replace sodamide with metallic sodium dissolved in liquid ammonia in the Baird reaction.

Just as a mixture of hydrogen gas (H_2) and oxygen gas (O_2) is not “similar” either chemically, physically or structurally to water (H_2O), neither is a mixture of metallic sodium Na, with ammonia NH_3 “similar” to sodamide, $NaNH_2$.

(2) Baird does not discuss formation of sodamide from metallic sodium.

Further, the examiner has indicated that Baird shows that sodium and ammonia react to form sodamide. This is incorrect. Baird discussed regeneration of sodamide from the endproducts, but does not discuss formation using metallic sodium. At col. 9, lines 50-60, Baird discusses the formation of sodamide through the operation of an electrolytic cell, where the endproduct Na_2S_4 is input to the anode of the cell. During cell operations, sodium ions are formed (Na^+), transmitted across the cell membrane, and form sodamide at the cathode (see figure 1 referenced cell 58). However, nowhere does Baird discuss the formation of sodamide from metallic sodium (valence zero) and ammonia directly. Indeed, Baird does not offer such discussion as metallic sodium dissolved in liquid ammonia *will not produce* substantial quantities of sodamide at the temperatures contemplated in the invention, absent a catalyst, such as a ferrous nitrate or other ferrous containing catalyst. Declaration of Dr. Schucker.

(3) There is no incentive to replace sodamide with metallic sodium in liquid ammonia.

Baird teaches the desulfurization reaction occurring at temperatures in the range of 400-

200°C (Baird, Col 2 lines 26-28), with preferred temperatures in the range of 750-1000°C. (Baird, Col. 3, lines 31-51). However, as taught by applicant, the sodium/ammonia solution is contacted with the organosulfur species at temperatures below 133°C, and preferably between 25-95°C. (Page 5 lines 1-5; page 4 lines 12- 16). In applicant's invention, once the sodium has been dispersed in the organosulfur species and the ammonia removed by flashing, hydrogen gas is added and the resulting process temperatures are raised to a preferred temperature of 25°C to 350°C, still well below the Baird process temperature. Indeed, as taught by applicant, raising the temperature of the metallic sodium/ammonia solution above 133°C is not desired, as above this temperature, the solubility of metallic sodium in ammonia decreases. Page 4, lines 14-18. Further, in applicant's invention, temperatures below the melting point of sodium (~98°C) are preferred to prevent the formation of molten sulfur and larger droplet size (page 5, lines 5-15). There is no motivation to replace sodamide in the Baird process with a sodium/ammonia solution, for the Baird process conditions would not produce the desired effect with metallic sodium. Indeed, Baird itself discusses the problems in the prior art with using sodium metals in desulfurization processes (col 1 lines 52-60) use of sodium or other alkali metals are known in desulfurization techniques, but are inefficient and produce contaminants). Baird solves this problem by replacing metallic metallic sodium with sodamide. Hence, Baird teaches away from using metallic sodium

Conclusion

Applicant's invention starts with a different chemical species than that taught in Baird, and there is no incentive to modify the Baird starting molecule with that of applicant's solution: metallic sodium in aqueous ammonia. It is believed that the application is now in a condition

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for allowance. It is therefore respectfully requested that the Examiner reconsider the rejections made in light of the amendments and remarks presented herein, and that the remaining pending claims be allowed. The undersigned asks that the Examiner contact him at (225) 248-2104 if he has any questions so that early allowance might be reached.

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Respectfully Submitted,



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